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Behavioural manifestations in Teleost, *Clarias batrachus* after exposure to heavy metal, Cadmium sulphate

Dr. Garima Pundir
Department of Zoology
R.G.P.G College , Meerut
gaarimaa112@yahoo.co.in

ABSTRACT: *In the present investigation behavioural changes in, Clarias batrachus were studied after exposure to heavy metal cadmium sulphate .The effects and the dosages were found to be directly proportional to the behaviour of the fish under study. The experimental fishes were exposed to four different doses of cadmium (0.5, 1.0, 1.5 and 2.0) mg/l for a period of 15 days. No prominent behavioural alterations were noted at 0.5 mg/l. At 1.0mg/l the animal began restlessness and exhibit mucus secretion. Erratic swimming, jerky body movements, rolling the body, convulsions, loss of equilibrium and mucous secretion over the body was observed at 1.5mg/l . At 2.0 mg/l concentration of cadmium loss of equilibrium, rapid opercular movement with difficulty in respiration was noted.*

KEY WORDS: *Behaviour, Clarias batrachus, cadmium sulphate*

INTRODUCTION

Cadmium is a nonessential heavy metal which is listed in the "Black list" of European community. It is the major contaminant of aquatic ecosystems causing adverse effects on aquatic organisms. Cadmium is reported to be associated with the effluents of battery, electroplating ,mining , metallurgy and paints industries. It occurs naturally in the environment, in less amounts but its release in the recent past is steadily increasing due to human activities causing pollution of soil and aquatic systems. The problem of appearance of heavy metals in aquatic ecosystem is associated with increased concentration of different types of pollutants, which enter water bodies and aquatic ecosystem.

Behavioral changes in fishes indicate internal disturbances and physiological irregularities in the body (**Larsson *et al* .,1961).** Eco-toxicological manifestations of aquatic habitat directly affect the behavioural and morphological parameters of fish due to immediate response to the presence of undesirable toxic elements in their vicinity.The present study focuses on the

behavioural changes in fresh water fish *Clarias batrachus* after exposure to cadmium sulphate**.** Fishes store, concentrate, metabolize toxicants exhibit behavioural alterations with morphological changes. They also act as biomarkers to detect the pollution status of water bodies. Behaviour allows an organism to adjust to the external and internal stimulus in order to meet the challenges of survival in a changing environment. Effects of heavy metals on the behavioural changes have been reported by many workers. Evidence of toxic effect of heavy metals has been reported on fishes and population eating contaminated food (**Chang, 1996).**

MATERIALS AND METHODS -

Healthy living specimen of teleost, *Clarias batrachus* were collected from local fish market of Meerut. Fish measuring 15 ± 2cm in length and 60 ± 8 gm in weight were selected for the present study. They were brought to the laboratory as soon as to lessen the high mortality. Prior to the experimentation, fishes were thoroughly washed for 5 minutes with 0·01 % $Kmno_4$ to avoid any dermal infection. Selected fishes were acclimatised to the laboratory conditions for period of 15 days. The Lc 50 was calculated by using Probit analysis method **(Finney,1971).** 96-hour median tolerance limit (96^{-} hr) Lc 50 was determined (at a static condition) by exposing the fishes to seven (2,4,6,8,10,12,14) mg/l ascending concentrations of cadmium sulphate cumulative mortality was determined after 96-hr. The 96-h Lc-50 13.8 mg/l for Cadmium Sulphate was determined by graphically plotting the percentage mortality versus concentration of chemicals. In order to investigate the behavioural changes in the experimental animal four different concentration of heavy metal cadmium sulphate (0.5,1.0,1.5 and 2.0) mg/l were selected. A separate group was maintained which served as control. The water in the aquarium was changed daily with dechlorinated water containing the same test concentration of cadmium. The experiment was conducted for period of 15 days and all behavioural changes were noted.

OBSERVATION –

The control fish were active throughout the test period and showed normal body balance and swimming pattern. Fishes showed avoidance behavior initially at 0.5mg/l with erratic swimming movements and jumping .At 1.0mg/l jerky movements, restlessness, erratic swimming, rolling the body, convulsion and mucus secretion was noted. At 1.5mg/l of cadmium concentration loss of equilibrium, mucous secretion was increased, with rapid opercular movements. Restlessness and convulsion with lethargy was much more pronounced at 2.0 mg/l of heavy metal cadmium sulphate exposure .Mucus secretion was observed at all 4 exposure period. At low concentration of cadmium avoidance behavior of cadmium is suggestive of accommodated and adaptive behavior .Fish exhibit difficulty in breathing , lethargic condition and convulsions as the concentration of cadmium increases .This is attributed to the disturbance of metabolic conditions , alteration in carbohydrate metabolism as a result of which there is depletion of energy. (Table 1)

Table 1: **Behavioural anomalies in *Clarias batrachus* after exposure of different concentrations of cadmium sulphate observed after 15 days of exposure period.**

Parameters	0.05mg/l	1.0mg/l	1.5 mg/l	2.0mg/l
Behavioural change	------	+	++	+++
Restlessness	…….	++	++	+++
Erratic swimming	+.	+	++	+++
Jerky body	……..	+	++	+++
Rolling of body	…….	…..	++	+++
Convulsions	……..	…..	++	+++
Mucus secretion	+	+	++	+++
Loss of equilibrium	…….	……	++	+++
Opercular movements	……..	…….	++	+++
Difficulty in breathing	……	…..	++	+++
Lethargic	…..	…..	++	+++

--- no response , + less moderate , ++ moderate response ,
+++intense response

DISCUSSION

The behavioural changes in fishes after exposure to different concentration of heavy metals has been studied by various workers from time to time .In the present investigation, avoidance behavior observed at 0.5 mg/l of cadmium sulphate is associated with change in sensitivity and chemoreception . Behavioural activities like hyperactivity, jumping, and restlessness were efforts made by fish to avoid toxicant. This avoidance reaction is related with the changed sensitivity of chemoreception as explained by **Svecevieus (2001) and Agarwal (1991)** in their studies **.**Increased secretion of mucous in *Clarias batrachus* is observed which is attributed to be the adaptive behaviour to avoid the absorption of toxicant by general body surface [**Das and Mukherjee, (2003), Yilmaz, (2004), and Prashanth *et al.*, (2005)].** Loss of equilibrium ,increased breathing ,lethargic condition, rapid opercular movements , after 2.0 mg/l concentration of cadmium is attributed to the energy depletion .This kind of behaviour is confirmed on several other fishes by various workers **Ellgaard and Guillot, 1988** in *Lepomis macrochiurs* treated with different concentration of copper. Lethargic response and frequent surfacing along with gulping of air exposure to 0.25 ppm copper was observed in *Heteropneustes fossilis* by **Singh and Reddy, 1990** in his study . In the present study, fish exhibited a variety of abnormal behaviour patterns such as hyperactivity, jumping from the media, restlessness, imbalance swimming, increased fin movement, increased opercular movement, and frequently gulping of air by quick surface visits. These observations are in agreement with those previously reported in fish exposed to other heavy metal toxicants viz., chromium and cadmium **Mishra and Mohanty, 2008 Narges *et al.*, 2010 and Yorulmazlar , 2003**. Jerky movements ,rolling of body, mucous secretion was observed at 1.5 mg/l these notable observation confirmed with

studies of to **Ghatak and Konar,1990** on *Tilapia mossambica* when exposed to cadmium it showed frequent surfacing with irregular opercular movements and loss of equilibrium. **MacLeod and Pessah, 1973** observed loss of equilibrium, frequent surfacing, sinking, burst of erratic swimming, and gradual onset of inactivity in Rainbow trout, *Salmo gairdneri*, on exposure to mercury .Behavioural abnormalities have been attributed to nervous impairment due to blockage of nervous transmission between the nervous system and various effectors sites (**Nriagu, 1970)** .

CONCLUSION

In the present study, the toxicity of cadmium and its harmful effect revealed various prominent abnormal behaviour such as erratic swimming, convulsion, loss of balance and difficulty in breathing in the experimental fish, *Clarias batrachus.* Difficulty in breathing, lethargic condition with loss of equilibrium and coordination in the animal at a higher concentration of cadmium was observed in the present investigation concludes.Thus it may be that cadmium interferes with nervous system of the fish.

REFERENCES

Agarwal SK, Bioassay evaluation of acute toxicity levels of mercuric chloride to an air breathing fish, Channa punctatus (Bloch.): Mortality and Behaviour study. J Environ Biol, 12: 99, (1991).

Chang, L.W. 1996. Toxicology of metals. CRC press Inc. Lewis Publishers, New York , USA.

Das, B.K. and Mukerjee, S.C. 2003. Effect of pyrethroid on the behaviour of Heteropneusta fossilis. Comp. Biochem. Physiol. C. Toxicol. Pharmacol. 134(1): 109-112.

Ellgaard, E. G., and Guillot, J.L. 1988. Kinetic analysis of the swimming behaviour of bluegill sunfish, Lepomis macrochirus Rafinesque, exposed to copper: hypoacitivity induced by sub lethal concentration, J. Fish. Biol. 33: 601-608.

Finney, D. J. 1971. Probit Anlaysis. Cambridge University Press, London.

Ghatak, D. B., and Konar, S.K. 1990. Acute toxicity of mixture of heavy metals cadmium, pesticides DDVP, detergent Parnol J and petroleum product n-heptane on fish , plankton and worm. Environ. Ecol. 8(4): 1239-1248.

Larsson, A., Bengtsson, B.E., and Svanberg, O. 1976. Some haematological and biochemical effects of cadmium on fish. In: Effects of pollutants on aquatic organisms.A.P.M. Lockwood ed. Cambridge University Press. pp 34-45.

McLeod, J.C and Pessah, E. 1973. Temperature effects on mercury accumulation, toxicity and metabolic rate in rainbow trout, Salmo gairdneri. J. Fish. Res. Board. Can. 30: 485-492.

Mishra AK and Mohanty B, Acute toxicity impacts of hexavalent chromium on behavior and histopathology of gill, kidney and liver of the freshwater fish, Channa punctatus (Bloch). Environ Toxicol and Pharmacol, 26: 136-141, 2008

Narges AB, Ahmad S, Mortazavi MS, & Zolgharnein H, Acute toxicity of cadmium chloride (CdCl2.H2O) on Chanos chanos and their behavior responses. World J. Fish and Marine Sci, 2: 481-486, (2010).

Nriagu, J.O. 1979. The biochemistry of mercury in the environment.(Elsevier/North- Holland) Biomedical press, New York.

Prashanth, M.S., David, M and Mathed, S.G. 2005. Acute toxicity of Paper mill effluents on the behaviour of freshwater Indian Cat fish wallagonia attu. J. Environ. Biol. 26(1): 73-82.

Singh, H.S., and Reddy, T.V. 1990. Effect of copper sulfate on haematology, blood chemistry and hepato somatic index of an Indian cat fish,Heteropneustes fossilis (Bloch) and its recovery. Ecotoxicol. Environ.Saf. 20: 30-35.

Svecevieus G, Avoidance response of rainbow trout, Oncorhyncus mykiss to heavy metal model mixtures. A com parasion with acute toxicity tests. Bull Environ Contam Toxicol, 67: 680-687, (2001).

Yilmaz, M., Gul, A and Erbasli, K. 2004.Influence of water hardness on cadmium toxicity to Salmo gairdneri (Rush). Bull. Environ. Contam.Toxicol. 56(4): 575-582.

Yorulmazlar E. Gul A, Investigation of acute toxicity of cadmium sulphate (CdSO4-H2O) and behavioral changes of grass carp (Ctenopharyngodon idellus Val., 1844). Chemosphere, 53: 10051010, (2003).